Patterns of Workers Returning to School Over the Business Cycle

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Abstract

In this paper we examine the cyclical properties of workers' decisions to re-tool and invest in new human capital. A model with different types of human capital (or "occupations") is developed with both idiosyncratic (i.e., occupation-specific) and aggregate shocks. At the beginning of each period workers can choose either to work in their current occupation, be unemployed and wait for conditions within their current occupation to improve, or to return to school in order to re-tool and join a new occupation in the next period. The model predicts that re-tooling will be procyclical. Empirical support for this hypothesis is sought using Canadian federal administrative data from 1979-93 that measures the flow of Canadian workers out of employment in order to return to school. Separation rates into education of long-tenured workers are found to be strongly procyclical.

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1. Introduction

It is important to understand the pattern of the demand for retraining services over the business cycle for training that is not normally subsidized by the UI (EI) system.

Choosing an occupation is one of the most difficult and important decisions that people make. This is particularly true in economies where occupations are highly specialized and require specific human capital investments. Returns to most occupations are affected not only by aggregate business conditions but also by conditions that are specific to individual occupations. There is inherent uncertainty about the future payoffs that specific occupations promise. In this paper we consider a simple competitive theory of occupational choice. A model is presented where workers choose occupations in the face of both idiosyncratic and aggregate shocks. A key prediction of this model is that occupational switching is procyclical. That is, more workers leave their existing occupations to re-tool in booms than in recessions. This prediction differs from what has been called the "opportunity cost" theory of restructuring, associated with Schumpeter (1939), and more recently by Caballero and Hammour (1994), Saint-Paul (1993), and others. According to the opportunity cost view, recessions are times when individuals take the time to re-tool since the opportunity cost, in terms of current foregone returns, is low.

No attempt is made in this analysis to look at the cyclical properties of retraining by the unemployed or those out of the labour force, and no claim is made that these groups will exhibit the same cyclical pattern as that observed for the employed. Rather, we focus on the decisions of employed workers who are a relatively less studied group since they are not eligible for most government programs. We argue that these workers, who bear the costs of leaving their job and returning to school, are an interesting group since their decisions provide insight into the optimal timing of the accumulation of human capital across the business cycle.

To explore the cyclical pattern of re-tooling empirically we exploit a unique Canadian federal administrative data set which measures the annual flow of workers who separate from a job in order to return to school, from 1979 to 1993. In Canada, whenever a job separation occurs, employers are required to file a Record of Employment (ROE) form with the federal ministry of Human Resources Development Canada (HRDC) stating, among other things, the reason for the separation. Using this data, we find that the rate at which workers leave their jobs to return to school is strongly procyclical. This holds true for both sexes and all age groups. This evidence, we contend, is supportive of the theory presented.

2. The Theory

The theory is very simple: there are many occupations, each of which has diminishing returns (i.e. the equilibrium wage decreases as the number of people skilled in that occupation increases). Switching from one occupation to another requires a costly investment in learning new techniques (re-tooling). The returns to each occupation are affected by both idiosyncratic shocks and general business conditions. The equilibrium concept used is that of perfect competition: each individual is too small to be able to have any effect on aggregate variables. To model this, we use a variant of Lucas and Prescott's (1974) equilibrium search model.

An occupation is defined as a set of jobs with a common human capital requirement. Switching occupations requires investment in new human capital: re-tooling.

Movement from one location to another requires that workers forfeit current wages. In our model we assume that all workers have a basic education, but must return to school if they wish to learn the skills required for a new occupation.

The structure of the model mirrors that of Gouge and King (1996), but the interpretation of the variables is different. Gouge and King extend Lucas and Prescott's model to include aggregate uncertainty and wait unemployment. The Lucas and Prescott model is, in essence, a dynamic stochastic variant of the migration model developed by Lewis (1954). In its simplest form, this model has multiple locations, each of which has a classical competitive labour market. Workers move across locations until expected returns, net of moving costs, are equated. By adding idiosyncratic local stochastic shocks to labour demands in each location, Lucas and Prescott were able to characterize a steady state level of aggregate worker movement. In their model, workers forfeit one period's wages if they choose to move, and movement is interpreted as search unemployment. By introducing aggregate shocks, Gouge and King were able to characterize the cyclical properties of the aggregate variables of the model. In Lewis' paper, locations are interpreted literally as geographic regions (the countryside and the city). In Lucas and Prescott's paper, locations are considered to be industries facing idiosyncratic demand shocks. In the Gouge and King paper, the interpretation of the locations is left open but, following Lucas and Prescott, worker movement is interpreted as search unemployment.

We interpret the locations as occupations. An occupation is therefore defined as a set of jobs with a common human capital requirement. Switching occupations requires investment in new human capital: re-tooling. Movement from one location to another requires that workers forfeit current wages. Time spent moving is interpreted as time spent back in school. (In our model we assume that all workers have basic education, but must return to school if they wish to learn the skills required for a new occupation.) Workers can also choose not to work, and not to learn new skills. The model allows for a low-paying alternative to working which can be interpreted as the value of leisure and/or payments from unemployment insurance. (Following the labour literature, we will refer to this as the “benefit rate”.) Workers who choose this alternative are said to choose “wait” unemployment. Every period, each occupation experiences two types of economic shocks: an occupation specific, and an aggregate one. Each shock takes on one of two values, high or low, and each type of shock is autocorrelated so that the state today provides information about the likely state of the economy tomorrow. Workers know the state of the economy and are forward looking. Wages in each occupation are affected by the two shocks and the number of workers in the occupation. We now turn to the formal representation of the model.

The Model

The economy consists of a large number of distinct productive occupations. A continuum of immortal worker-consumers choose which occupation to occupy in each (discrete) time period. Each worker can, in any period, hold only one occupation. If, in any period, a worker chooses to work in his current occupation, he inelastically supplies one unit of labour and receives the current marginal return in that occupation. The returns available in each location are subjected to both idiosyncratic (i.e., occupation-specific) and aggregate shocks. The idiosyncratic and the aggregate shocks all evolve independently. The marginal return (denominated in terms of the single good in this economy) available in occupation I in period t is given by:

(2.1) $$y^i_t = y^i_t \theta_t g(n^i_t)$$

where y^i_t denotes the idiosyncratic shock, θ_t denotes the aggregate shock, n^i_t denotes the number of workers in occupation I, and g is continuously differentiable with:

(2.2) $$g' < \theta, \lim_{n\to\infty} g(n) = 0, \lim_{n\to\infty} g(n) = \infty$$

The idiosyncratic and aggregate shocks follow independent first order Markov processes. Each shock can take two values: θ 0 Θ = _ θ_H, θ_L _ where $0 < \theta_L < \theta_H$; and γ0Γ = γ_H, γ_L where $\gamma_H > \gamma_L > 0$. The transition matrix P for the aggregate shock is assumed to be symmetric with persistence parameter $\rho \geq$ %. The transition matrix P for the local shocks is assumed to be symmetric with persistence parameter $\pi >$ %.

Worker-consumers observe all current information, have rational expectations, and maximize the expected discounted value of their income stream. They decide in each time period whether to work in their current occupation or to re-tool and learn a new one. Re-tooling takes one time period so, if they re-tool, workers forego the payoff in their current occupation in return for the expected payoff in the occupation that they are matched with at the end of the period.[1] Re-tooling workers are allocated at the end of the period in such a way that the expected payoff in all occupations that receive workers is equalized. Define this allocation by a measure, I, over states.

Workers that choose not to re-tool in the current period may choose whether or not to work in their current location. Those choosing to work supply one unit of labour inelastically at the current payoff. Those who choose not to work collect the constant benefit rate ω , and are called "unemployed". The Inada condition (2.2) implies that all occupations will have some people working in them. Hence, in any occupation where some people choose unemployment, the equilibrium return from working must equal ω.

Equilibrium Behaviour

Let x^t_i denote the number of workers in occupation I at the beginning of period t. The pair (x,γ) defines the state of an occupation. Let $v_t(x,y)$ denote the equilibrium mass of occupations with state (x,γ). Attention is restricted to stochastically stationary equilibria in which the equilibrium behavioural functions depend only on the state and the current value of the aggregate shock. We can therefore use the triple (x,γ,θ) to index types of occupations.

Let $s(x,\gamma,\theta)$ denote the number of workers in occupations of type (x,γ,θ) who decide to re-tool (that is, leave their current occupation to return to school) at the beginning of the period. Let $a(x,\gamma,\theta)$ denote the number of workers who arrive (re-tooled) in occupations of type (x,γ,θ) at the end of the period. Let β denote the expected payoff to workers who stay in occupations of type. Let β denote the workers' discount factor, then $v(x,\gamma,\theta)$ is defined by:

(2.3) $v(x,\gamma,\theta)= \mathbf{max}$ _ $\omega,\gamma\ \theta\ g(x\text{-}s)$ _+ β_ $E[v(x\text{-}s + a,\gamma',\theta)$_$x,\gamma,\theta]$

The expected value of re-tooling is:

(2.4) $\lambda^s(x,\gamma,\theta) = \beta$_ ò $E[v(x\text{-}s\text{+}a,\gamma',\theta')$_$x,\gamma,\theta]\ I\ (dx\text{-}d\gamma)$

[1] Introducing an extra fixed cost of earning would not change the results of this model. What is important is that current wages are foregone when re-tooling in anticipation of future higher wages.

and the expected value of choosing unemployment is:

$$(2.5) \qquad \lambda^{r}(\mathbf{x},\gamma,\theta) = \omega+\beta\_ \ E[\mathbf{v\text{-}s\text{+}a},\gamma',\theta')\_\mathbf{x},\gamma,\theta]$$

Wherever workers leave from, (i.e., where $s(x,\gamma,\theta)>0)$ the workers who choose to stay behind must, in equilibrium, be indifferent about whether they chose to stay or leave. Thus, the equilibrium value associated with an occupation in which some workers leave is $\lambda^s(x,\gamma,\theta)$. Wherever workers choose to arrive, (i.e., where $a(x,\gamma,\theta)>0$) the value of the occupation to each new arrival is $\lambda^s(x,\gamma,\theta)$ at the end of the period. Thus, the value to a worker in one of these occupations at the beginning of the period is $\lambda^s(x,\gamma,\theta)$ plus the current payoff available in that occupation. In any other occupation, which neither loses nor gains workers, the value to workers is the current payoff plus the expected (discounted) value next period, given the current population. Thus, we can re-write the value function as:

$$(2.6) \quad v(x,\gamma,\theta)= \begin{array}{l} \lambda^s(x,\gamma,\theta) \quad \textbf{if} \quad s(x,\gamma,\theta) \\ \lambda^s(x,\gamma,\theta) + \mathbf{max} \ \{\omega,\gamma\ \theta\ g(x)\} \quad \textbf{if} \quad a(x,\gamma,\theta)>0 \\ \mathbf{max}\ \{\omega,\gamma\ \theta\ g(x)\} + \beta\ E[v(x,\gamma',\theta)\gamma,\theta] \ \textbf{in all other locations} \end{array}$$

We are now in a position to define an equilibrium in this model.

Definition 2.1:

An equilibrium, given an initial distribution, v_{t-1}, and an initial value for the aggregate shock θ_{t-1}, is a collection of functions $y(x,\gamma,\theta)$, $\lambda(\theta)$, $n(x,\gamma,\theta)$, $s(x,\gamma,\theta)$, $a(a,\gamma,\theta)$, $v(x,\gamma,\theta)$ and a distribution v_t such that:

a) Workers are maximizing the expected present value of their income streams (that is, (2.3) and (2.6) are equalized).

b) In locations which any workers leave, the expected value of returning to school and the expected value of unemployment are equalized, and are independent of x and γ:

$$(2.7) \qquad \lambda^{s}(\theta) = \lambda^{r}(\theta) = \lambda(\theta)$$

c) The aggregate number of workers who leave occupations equals the aggregate number of arrivals in other occupations. That is:

$$(2.8) \qquad S(\theta,v) = \text{ò} \ s(x,\gamma,\theta)\ dnu = a(x,\gamma,\theta)\ dv = A(v,\theta)$$

d) The following condition is satisfied, which requires that the equilibrium distribution after re-tooling, v_t, must be consistent with the optimizing decisions of agents, given v_{t-1}:

(2.9) $$v_t(\theta, v) = \int 1_{x-s+a=x1}(x)\_P(\gamma_1 - \gamma)\, v_{t-1}(dx, d\gamma)$$

Equations (2.3) through (2.9) can be used to solve for the equilibrium levels of employment and population in each occupation. As mentioned above, the distribution v_t will not generally be constant because of the aggregate shock θ. However, the stochastic process generating the_v_t_ sequence is stationary.

3. Equilibrium Properties of Re-tooling and Unemployment

In this paper, following Gouge and King (1996), we focus on a particular subset of the equilibria that are both tractable to compute and (we contend) relevant economically. In these equilibria, the _v_t_ sequence has only 8 mass points. Also, high productivity occupations, in both booms and busts, have equilibrium payoffs above ω, and so do not experience any unemployment. Equilibrium payoffs in low productivity occupations are driven down to _v_t_ in both booms and busts, so that these locations experience some unemployment in each phase of the cycle. (The aggregate amount of unemployment does, however, vary over the cycle.)

The aggregate equilibrium amounts of re-tooling and unemployment are defined respectively as:

$$S(\theta, v) = \int s(x,\gamma,\theta) \; v\,(dx\text{-}d\gamma)$$

$$U(\theta, v) = \int [\, x - s\,(x,\gamma,\theta) - n\,(x,\gamma,\theta)\,]\; v\,(dx\text{-}d\gamma)$$

To proceed, we need to define what we mean by "cyclical properties." The simplest way to analyse the cyclical properties of the variables of interest is to examine their values for different values of θ. Thus we call a variable "procyclical" if its value is greater when $\theta = \theta_H$, and "countercyclical" if its value is greater when $\theta = \theta_L$. We use two different methods to characterize cyclical properties. First, we ask: given the same beginning-of-period *v*, would the equilibrium values of these variables be greater when $\theta=\theta_H$ or $\theta=\theta_L$? Second, we examine the values of the variables in the two limiting equilibria that emerge in the unlikely event that the aggregate shock θ persists at one of its two possible values indefinitely. These two limiting equilibria are called the "eternal boom" and the "eternal bust", for unbroken sequences of θ_H *and* θ_L respectively. The following theorem summarizes the cyclical behaviour of re-tooling and unemployment in this equilibrium.

Theorem

In the eight mass-point equilibrium, search and unemployment have the following properties:

$$U\,(\theta_H, v) < U\,(\theta_L, v_L) \qquad U\,(\theta_H, v_H) < U\,(\theta_L, v_L)$$

$$S\,(\theta_H, v) \geq U\,(\theta_L, v_L) \qquad S\;\theta_H, v_H) \geq S\,(\theta_L, v_L)$$

For both men and women, re-tooling, that is leaving one's job to return to school, seems to be strongly procyclical, the rate increases in booms.

Moreover:

i) if ρ=.5 then $\boldsymbol{S(\theta_H, v) = U(\theta_L, v)}$ then $\boldsymbol{S(\theta_H, v_H) = S(\theta_L, v_L)}$

ii) if ρ=.5 then $\boldsymbol{S(\theta_H, v) > U(\theta_L, v)}$ then $\boldsymbol{S(\theta_H, v_H) > S(\theta_L, v_L)}$

Proof: See Gouge and King (1996), Proposition 5.1.

Interpretation

The first row of inequalities in this theorem implies that unemployment is countercyclical (as we should expect). The first inequality states that, given any beginning-of-period equilibrium distribution, unemployment is higher in busts than in booms. According to the second inequality, unemployment would also be higher in the eternal bust than in the eternal boom. Equilibrium unemployment is countercyclical for obvious reasons: in busts, the payoffs in all occupations are driven down, and so more people choose to collect ω.

Equilibrium re-tooling is independent of the cycle if $\rho = .5$. This occurs because workers do not receive the benefits from re-tooling until the subsequent period. When $\rho = .5$, knowledge of the current value of the aggregate shock reveals no useful information about future payoffs: the following period's aggregate shock is just as likely to be a boom or a bust. The *cost* of moving is also constant over the cycle: one period's wages in low productivity occupations, which is equal to ω.

However, if $\rho > .5$, then a boom in the current period implies that a boom is more likely than a bust in the subsequent period. Payoffs in high productivity occupations are greater in booms than in busts, so the benefits from re-tooling are greater in booms. The cost of re-tooling is still constant at ω in this case. Thus the second row of inequalities in the above theorem states that more re-tooling is undertaken in booms than in busts, given any beginning-of-period equilibrium distribution, and more re-tooling occurs in the eternal boom than in the eternal bust. In summary, re-tooling is procyclical.

4. Evidence

Data

The data to which we have access is from the HRDC administrative files and represents a 10% random sample of all ROEs. It is a national, and consistently defined, annual count of the number of firm-worker separations for the years 1979 to 1993. In accordance with the coverage of this collection process, the population under study is all paid workers who are not self employed. Additionally, the age and sex of the worker, and the length of the job that terminated, can be identified for each separation. Thirteen "reason for separation" categories, one of which is "return to school," are on the current version of the ROE form, but only one is recorded for each separation.[2] If a worker, for example, is laid off, dismissed for cause or voluntarily quits to take another job and subsequently decides to return to school, then she is not counted in this measure. The "return to school" reason is only observed where the declared intention of the worker at the time of separation is to return to school. Since some workers who, for example, are laid off or in the "other" category undoubtedly also return to school, our measure is an underestimate of the flow from employment to school and of formal human capital accumulation.

HRD's administrative files provide a 10% random sample of all Records of Employment (ROEs). It is a national, and consistently defined, annual count of the number of firm-worker separations for the years 1979 to 1993. In accord with the coverage of this collection process, the population under study is all paid workers who are not self-employed... We look at the business cycle pattern of the "return to school" reason for leaving employment. It is only observed where the declared intention of the worker at the time of separation is to return to school.

It seems reasonable to assume that the return to school category comprises two types of firm-worker separations: first, those resulting from what are effectively limited term — typically called summer — jobs held by students in the process of obtaining their education, and second, those where workers return to school and the job was not of limited term. It is the latter in which we are most interested in this study as it can be thought of as quantifying one aspect of retraining, or human capital re-tooling, since the workers in question are making a decision to leave their occupation and return to formal education. We make an effort, based on age and job duration, to isolate these subclasses of the return to school reason for separation.

Time series from Statistics Canada's CANSIM database are used to contrast the cyclical properties of the return to school series. In particular, GDP and investment, both in 1986 dollars, and age specific unemployment rates are employed (see Appendix 1). The investment and GDP series are divided by average annual employment, and natural logarithms are then taken of both. Each series is divided by the age specific employment level. Males and females

2 The 13 reason categories are: short work (layoff), labour dispute, return to school, injury/illness, voluntary departure, pregnancy, retirement, work-sharing, apprenticeship, age 65, dismissal, leave of absence, and other. The list of reasons has remained remarkably stable over the period; the major exception is the addition of the dismissal group in 1990.

A high fraction of jobs ending in "return to school" last less than 20 weeks; many of these are likely summer jobs held by students. To examine the more stable jobs, we produce results, by age and sex, for jobs that lasted at least 20 weeks, as well as for jobs with any number of preseparation weeks.

are analysed separately in two age groupings: those 15 years and older, which accords with Statistics Canada's definition of the labour force; and 25 to 54 year old prime age workers.[3] The latter group is past the normal age by which most students have completed their first postsecondary degree or certificate, and therefore provides a measure that is less contaminated by summer job availability across the business cycle. Table 1 presents summary statistics for the distribution of job lengths for the years 1983 and 1989 which are at the trough and close to the peak of the return to school series. For the sample of all workers over 15 years of age, the average complete job duration is somewhat over half a year, and it is slightly longer in the trough (1983). Also, the durations are longer for women than men at 36.2 and 29.1 weeks respectively in 1983, and 30.4 and 24.7 in 1989. In all cases, however, the median is very short, around 14 or 15 weeks. For the older age group, on the right of Table 1, the distribution is shifted toward longer durations, but women continue to have longer durations than men. Further, the distribution for prime age males appears to be very similar in the peak and trough years, whereas that for the other three groups exhibits a larger fraction of shorter durations in the peak years.

A histogram of the job lengths, ignoring all jobs longer than 50 weeks for clarity, can be seen in Figure 1. It is clear from the plot that a high fraction of jobs ending in "return to school" last less than 20 weeks; many of these are likely summer jobs held by students since 20 weeks is quite close to the length of many universities' summer break. To examine the more stable jobs independently of the short term ones, we produce results by age and sex for jobs with any number of preseparation weeks, and for jobs that lasted at least 20 weeks. Although this is, in a sense, stratifying the sample on an endogenous variable, as discussed above, we perform the exercise in an attempt to isolate two "types" of jobs. We will show, however, that the results for the two groups are very similar.

Table 2 presents the age distribution of workers returning to school who held their preseparation job for at least 20 weeks. Fully 95% of the individuals are in their early 30's or younger. Further, there is no difference in the distributions across the business cycle, or between the sexes.

The series are summarized in Tables 3 and 4 for jobs of any length, and for those greater than 20 weeks, respectively. Summary statistics of the return to school series for men are presented in the top half of Table 3. Each year an average of about 125,000 males aged 15 and over leave a job and return to school. This represents about 1.8% of employment and varies from 1.08% to 2.41%. About 20,000 men aged 25 to 54, which is about 0.42% of the total number of employed men in this age group who were employed, similarly

[3] Many of the analyses are also conducted for a 30-54 age group sample; the cyclical properties of the series are very similar to that for those 25-54.

chose to re-tool each year on average. The female rate is significantly lower than that for the males: 1.28% and 0.27% for the 15 and over, and 25 to 54 year old groups respectively. This translates into annual averages of about 89,000 and 13,000 workers who return to school for the same age groups.

Each year an average of about 13,000 women and 20,000 men aged 25 to 54 chose to re-tool.

Table 4 presents similar statistics to Table 3, but for those whose preseparation job was at least 20 weeks long. The overall levels are reduced, and the gap between the male and female rates is slightly smaller for this group; the female rate is 26% less than that for the males here, whereas it is 36% less for any number of weeks worked. While the fraction of prime age employed workers who return to school is small in a given year, these individuals represent an important segment of the work force and, over a number of years, the number of workers involved is not insignificant. Overall, the average annual re-tooling rate for the male 25 to 54 age group is 0.42% for any number of preseparation weeks, and 0.19% for those with greater than 20 weeks of tenure. This suggests that if workers each only re-tool once, roughly 12.6% (30*0.42) of all male workers return to school to re-tool at some point in their prime working years. About 5.7% (30*0.19) of male workers with a pre-separation job of at least 20 weeks return to school to re-tool at some point in their prime working years. The corresponding numbers for females are 8.1% (30*.27) and 4.2% (30*.14). Since some workers between the ages of 25-54 undoubtedly separated from multiple jobs to return to school, we take this as an upper bound on the propensity for workers to return to school.

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Figures 2 through 5 contrast both the selected business cycle series, and the residuals from the same series after detrending using the Hodrick-Prescott (H-P: 1980) filter, with the return to school rate and its residuals.[4] Each figure contains 6 graphs: the upper 3 compare the return to school rate and, from right to left, the unemployment rate, (log) GDP per employed person, and (log) investment per employed person. The lower 3 graphs are the Hodrick-Prescott filtered residuals for the series above it. Since we are using the logarithm of the GDP and investment series, this implies that the residuals are percentages, not absolute, deviations. Note that the re-tooling series extends 15 years (1979-93), but that the other series start in 1976 and end one or two years beyond the end of the human capital accumulation series depending upon data availability. This provides a better sense of the trend and, in the analysis of the correlations, allows for the non-education series to be lagged or lead while retaining the 15 years of schooling data. Since the H-P filter is being applied to only 15 annual observations, the results based on it should only be viewed as suggestive.

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4 The smoothing parameter was set to 100 for this exercise in order to be comparable with other studies. See Baxter and King (1995), or King and Rebelo (1993) for a discussion of the choice of the smoothing parameter for data of different frequencies. A wide range of parameter values were tried, but none caused the results to change substantively.

Workers who are between the age of 25 and 54 (hence, unlikely to be working through summer jobs) go back to school when the unemployment rate is low, not high. Similarily, the cyclical component of the "return to school" series is positively correlated with physical capital investment and GDP.

Looking at Figure 2, which is for men between the ages of 25-54 with any number of weeks of work prior to returning to school, the return to school rate, which is the same in the three upper plots, does not appear to have a noticeable trend, although the series is too short to say much on the issue. Its cyclical nature is, however, evident. In contrast, the three other series are all noticeably increasing across the period in addition to having an obvious cyclical component. Looking for comovements in the deviations from the trend using the H-P residuals of the schooling and unemployment rate series, on the lower left, one series appears to peak when the other hits a trough as predicted by the earlier theoretical analysis. In contrast, in the middle plots, the education rate residuals seem to move with GDP, but with a lag. On the right, the physical and human capital series residuals are seen to move together across the business cycle, but in this case human capital seems to precede physical for at least the latter two-thirds of the period.

Figure 3 presents graphs for females similar to those presented for males in Figure 2. One noticeable difference in the education series is that, unlike that for the men, the level increases noticeably over the period. In rough terms the female return to school rate is about 45% of that for males in the first few years of the period, but it is about 75% that of males near the end. Despite this difference in the trend, the residual plots are remarkably similar. The schooling and unemployment rates are countercyclical to each other, and the GDP and investment series move together with our measure of human capital accumulation, although there appears to be a phase shift relative to GDP.

Plots for those who worked at least 20 weeks in the job in question before returning to school are presented in Figure 4, for males who are 25-54, and in Figure 5, for females of the same age. The major difference from the earlier series is that the rate increases more slowly over the mid to late 1980s. This causes the return to school residuals to move more closely with those for investment, and to separate more from those for GDP. No graphs are presented for those 15 years old and older since they are very similar to those already discussed. Their correlations are, however, presented below. Contemporaneous and cross correlations for the H-P residual series are presented in Table 5, for those with any number of weeks worked prior to separating, and Table 6, for those with greater than 20 weeks. For all of the groups studied there is a large and significant negative contemporaneous correlation between the return to school and unemployment rate residuals which is consistent with that observed in the graphs. The contemporaneous correlations between the schooling and investment residuals are moderate and sometimes significant. When investment one period ahead is used, however, the correlation remains moderate, around 0.45 to 0.60, but it is significant at least at the 10% level in every test. Residual correlations with GDP are significant, but they are out of phase with the return to school rate. All the contemporaneous correlations are small and insignificant. In contrast, those lagged one year are between 0.50 and 0.85 and universally significant at the 6% level or better. When the GDP residuals are lagged two years, the correlation usually becomes slightly larger and more significant. It seems that human capital re-tooling lags GDP by a year or two. Usually, however, when the GDP residuals are forwarded one year, and always when they are forwarded two years, the correlation coefficient has a negative and significant coefficient of moderate size. This is consistent with the two series being out of phase and the cycle being relatively short. If the GDP series is lagged it is in phase with the return to school cycles, and if it is forwarded two periods the peaks and troughs of the series align.

5. Conclusion

The theory implies that, if the aggregate shock exhibits positive autocorrelation (i.e., when $\rho > .5$), then re-tooling will be procyclical. The basic reasoning behind this is that the benefits to re-tooling come from expected future returns, and expected future returns are higher in booms; however, the costs of re-tooling are invariant to the cycle. This reasoning is a variant of the "capitalization effect", discussed in the growth literature (Aghion and Howitt (1994), King and Welling (1995)). In economies in general, this capitalization effect works in the opposite direction to Schumpeter's "opportunity cost" effect. In this model, the opportunity cost effect is zero because the foregone opportunity when re-tooling is constant over the cycle (ω). Deciding which effect dominates, in general, is an empirical question.

The basic reasoning behind procyclical re-tooling is likely that the benefits to re-tooling come from expected future returns, and expected future returns are higher in booms; however, the costs of re-tooling are higher in booms, and are invariant to the cycle since the worker must leave her/his source of income.

Empirically, the capitalization effect appears to dominate. Returning to school to re-tool is strongly procyclical. This comes out most clearly in Figures 4 and 5. Workers who are between the age of 25 and 54 (and hence, unlikely to be working summer jobs) go to back to school when the unemployment rate is low, not high. This cyclical effect is also positively correlated with physical capital investment and GDP.

Table 1
Distribution of Job Lengths (Weeks of Work) Prior to Returning to School in 1983 and 1989

Males	15+		25-54	
Centiles	1983	1989	1983	1989
5	3	3	3	3
25	9	8	11	12
50	15	14	18	17
75	24	18	51	45
95	12	83	210	214
Avg.	**29.1**	**24.7**	**50.5**	**50.1**
(Std. Err.)	(.601)	(.422)	(2.472)	(1.978)

Females	15+		25-54	
Centiles	1983	1989	1983	1989
5	4	4	4	5
25	10	9	13	12
50	15	14	31	22
75	33	21	99	70
95	144	111	274	329
Avg.	**36.2**	**30.4**	**74.1**	**68.9**
(Std. Err.)	(.897)	(.587)	(3.947)	(2.653)

Table 2
Age Distribution of Those Who Return to School in 1983 and 1989 (At least 20 weeks worked)

Males	15+		25-54	
Centiles	1983	1989	1983	1989
5	17	16	25	25
25	19	19	25	25
50	21	21	27	28
75	23	23	31	32
95	30	31	42	41
Avg.	**22.0**	**21.6**	**29.5**	**29.6**
(Std. Err.)	(.056)	(.042)	(.158)	(.110)

Females	15+		25-54	
Centiles	1983	1989	1983	1989
5	17	17	25	25
25	19	19	25	25
50	21	20	29	29
75	23	23	34	35
95	32	33	45	44
Avg.	**21.9**	**21.7**	**31.0**	**31.1**
(Std. Err.)	(.076)	(.051)	(.239)	(.146)

Table 3
Summary Statistics of the Return to School Category (Any number of weeks worked)

Males	Avg/yr	Std Dev	Min	Max
Counts of Those Returning to School				
25-54	20,045	3,319	12,630	25,590
15+	124,760	22,070	70,270	158,500
Return to School as a Fraction of E (%)				
25-54	.42	.05	.29	.49
15+	1.80	.31	1.08	2.41
Females				
Counts of the Return to School Category				
25-54	12,869	3,771	7,030	18,340
15+	88,693	18,013	45,030	113,670
Return to School as a Fraction of E (%)				
25-54	.27	.06	.16	.35
15+	1.28	.22	.70	1.54

Note: "E" is the total number of men and women employed in each age group.

Table 4
Summary Statistics of Return to School (At least 20 weeks worked)

Males	Avg/yr	Std Dev	Min	Max
Counts of the Return to School Category				
25-54	8,891	1,446	5,920	11,120
15+	29,718	4,498	20,350	39,190
Return to School as a Fraction of E (%)				
25-54	.19	.03	.14	.24
15+	.43	.06	.31	.59
Females				
Counts of the Return to School Category				
25-54	6,771	1,792	3,990	9,530
15+	24,247	4,711	14,790	31,820
Return to School as a Fraction of E (%)				
25-54	.14	.03	.09	.18
15+	.35	.05	.23	.43

Note: "E" is the total number of men and women employed in each age group.

Table 5
Cyclical Behaviour of Returning to School and the Unemployment Rate, Investment and GDP Correlations of Deviations from H-P Trend (Any number of weeks worked)

	Cross Correlations of the Return to School Rate				
Variable x	**x(t-2)**	**x(t-1)**	**x(t)**	**x(t+1)**	**x(t+2)**
Males 25-54					
UR	.02	-.58**	-.83***	-.46*	-.06
	(.938)	(.024)	(.000)	(.079)	(.824)
INV	-.33	.16	.55**	.55**	.42#
	(.226)	(.561)	(.033)	(.033)	(.133)
GDP	.77***	.73***	.06	-.51**	-.57# **
	(.001)	(.002)	(.815)	(.051)	(.032)
Males 15+					
UR	.28	-.35	-.79***	-.61**	-.32#
	(.303)	(.196)	(.000)	(.016)	(.270)
INV	-.53**	-.07	.40	.63***	.54# **
	(.040)	(.809)	(.138)	(.012)	(.045)
GDP	.64***	.85***	.30	-.34	-.58# **
	(.009)	(.000)	(.277)	(.208)	(.030)
Females 25-54					
UR	.32	-.27	-.67***	-.62**	-.27
	(.244)	(.338)	(.006)	(.012)	(.322)
INV	-.30	.12	.43	.52**	.45# *
	(.270)	(.679)	(.109)	(.046)	(.105)
GDP	.73***	.77***	.24	-.36	-.51# *
	(.002)	(.001)	(.374)	(.191)	(.059)
Females 15+					
UR	.47*	-.13	-.63**	-.69***	-.42
	(.078)	(.646)	(.012)	(.004)	(.113)
INV	-.50*	-.11	.28	.60***	.54# **
	(.060)	(.706)	(.316)	(.019)	(.048)
GDP	.60**	.85***	.39	-.24	-.56# **
	(.018)	(.000)	(.156)	(.390)	(.039)

Notes:
All of the lags or leads involve lagging or leading the UR, INV or GDP series so that all 15 years of education data can be employed. Correlations with an "**#**" use only 14 observations since data for the second lead is unavailable in all years. The numbers in parentheses are p-values for the test of the null hypothesis that the correlation is zero:

$$p = tprob(n - 2, \rho \sqrt{n-2} / \sqrt{1-\rho^2}).$$

Where ρ is the estimated correlation and n is the number of observations. *, **, *** represent statistical significance at the 10, 5 and 1% levels respectively. Note that because of the small sample size, these statistics must be interpreted with care.

Table 6
Cyclical Behaviour of the Return to School Rate and the Unemployment Rate, Investment and GDP Correlations of Deviations from H-P Trend (At least 20 weeks worked)

Variable x	Cross Correlations of the Return to School Rate x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)
Males 25-54					
UR	-.26	-.69***	-.72***	-.29	.10
	(.343)	(.004)	(.002)	(.291)	(.711)
INV	-.12	.29	.53**	.45*	.30#
	(.666)	(.292)	(.043)	(.095)	(.289)
GDP	.73***	.50*	-.18	-.65***	-.63# **
	(.002)	(.059)	(.528)	(.009)	(.015)
Males 15+					
UR	-.11	-.57**	-.74***	-.36	-.08#
	(.698)	(.026)	(.002)	(.185)	(.772)
INV	-.222	.15	.41	.50*	.40#
	(.426)	(.593)	(.125)	(.058)	(.156)
GDP	.69***	.60**	-.08	-.56**	-.62# **
	(.004)	(.017)	(.764)	(.030)	(.017)
Females 25-54					
UR	-.30	-.32	-.71***	-.63***	-.21
	(.283)	(.250)	(.003)	(.012)	(.446)
INV	-.29	.15	.48**	.52**	.42#
	(.293)	(.601)	(.069)	(.044)	(.130)
GDP	.77***	.75***	.18	-.43	-.51# *
	(.001)	(.001)	(.517)	(.107)	(.065)
Females 15+					
UR	.17	-.39	-.70***	-.52**	-.16
	(.546)	(.150)	(.004)	(.048)	(.556)
INV	-.28	.15	.35	.47*	.33#
	(.318)	(.595)	(.205)	(.074)	(.246)
GDP	.61**	.69***	.10	-.43	-.59# **
	(.016)	(.005)	(.727)	(.109)	(.025)

Note:
All of the lags or leads involve lagging or leading the UR, INV or GDP series so that all 15 years of education data can be employed. Correlations with an "#" use only 14 observations since data for the second lead is unavailable in all years. The numbers in parentheses are p-values for the test of the null hypothesis that the correlation is zero:

$$p = tprob(n - 2, \rho \sqrt{n-2} / \sqrt{1-\rho^2}).$$

Where ρ is the estimated correlation and n is the number of observations. *, **, *** represent statistical significance at the 10, 5 and 1% levels respectively. Note that because of the small sample size, these statistics must be interpreted with care.

Figure 1 - Job Length at Peak and Trough of Cycle forJobs Lasting 50 Weeks or Less

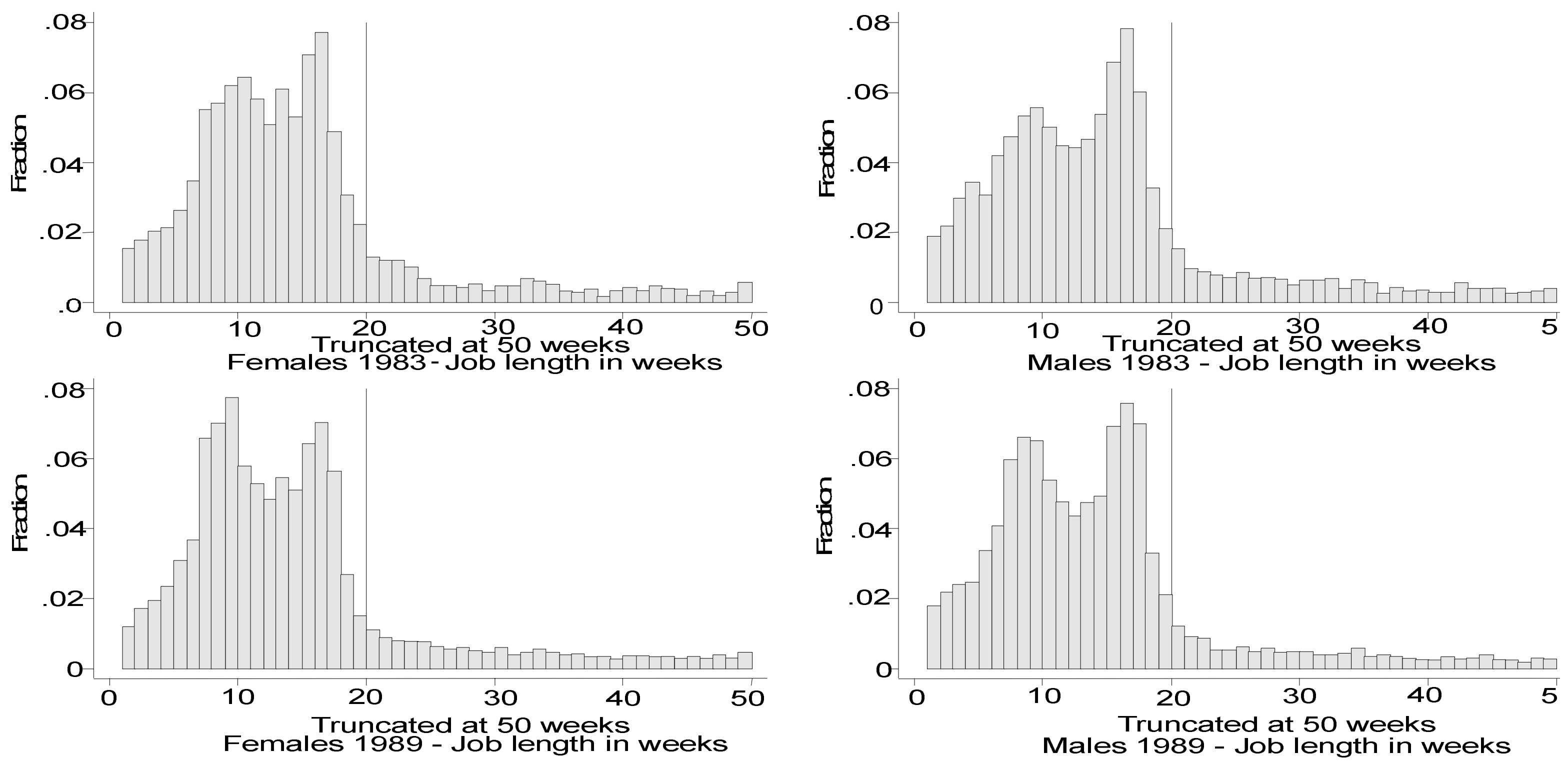


Figure 2 - Rates and H-P Residuals for Males 25-54, Any Number of Weeks Worked

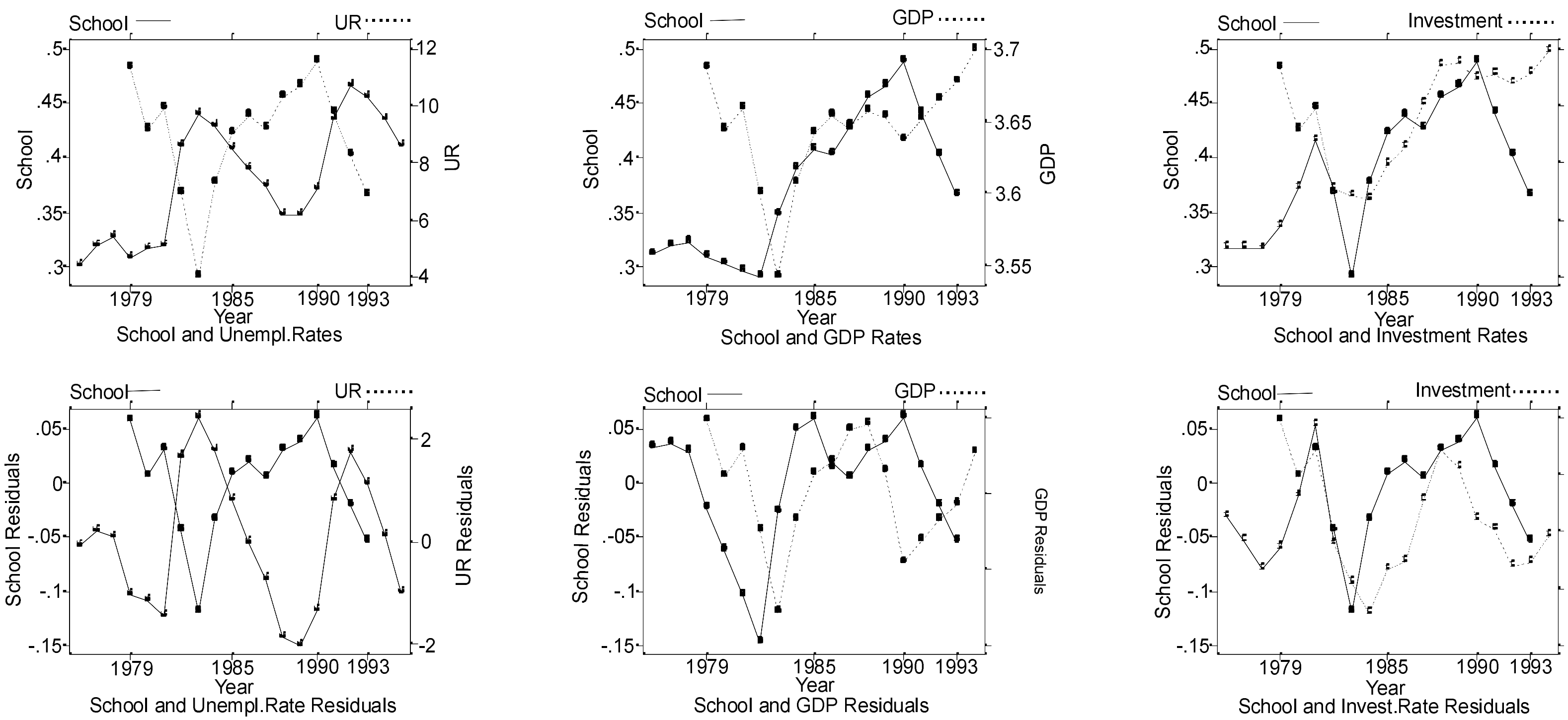


Figure 3 - Rates and H-P Residuals for Females 25-54, Any Number of Weeks Worked

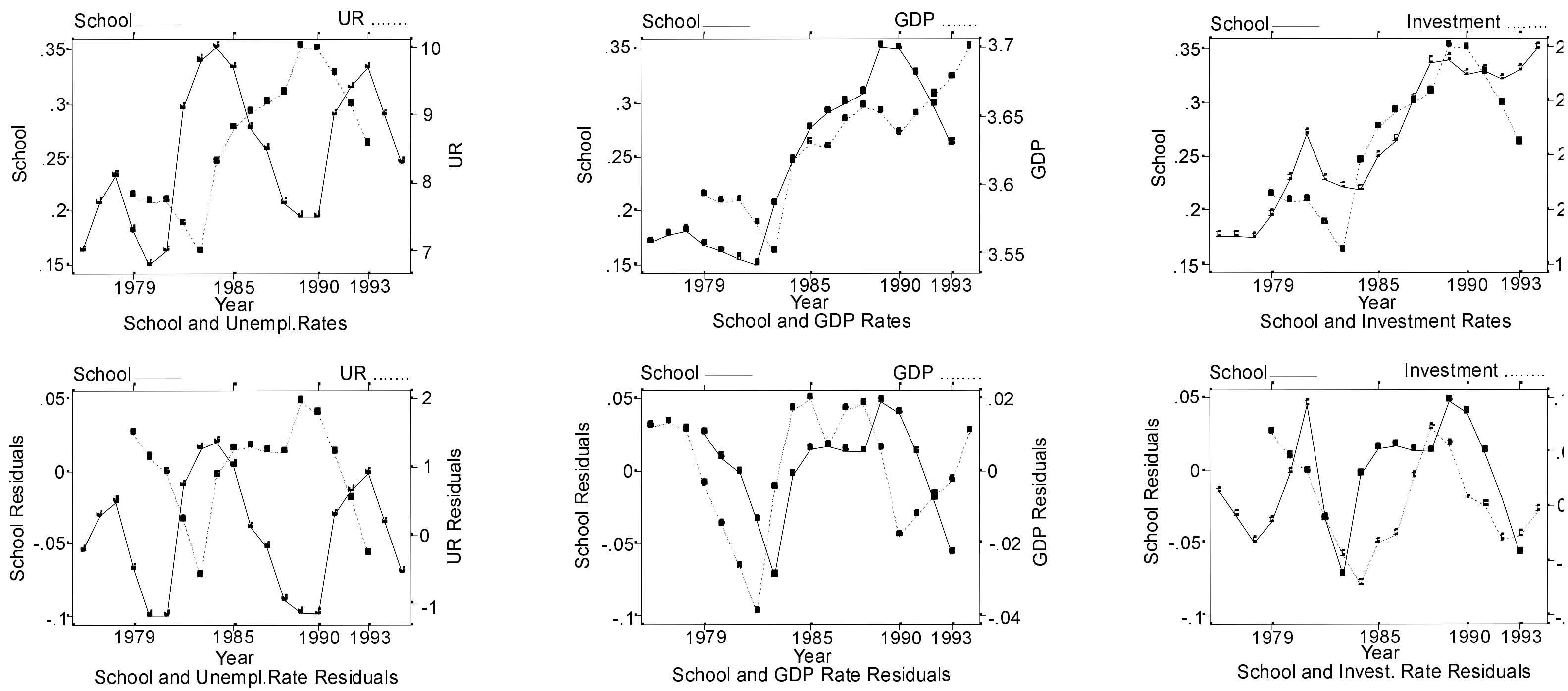


Figure 4 - Rates and H-P Residuals for Males 25-54, > 20 Weeks Worked

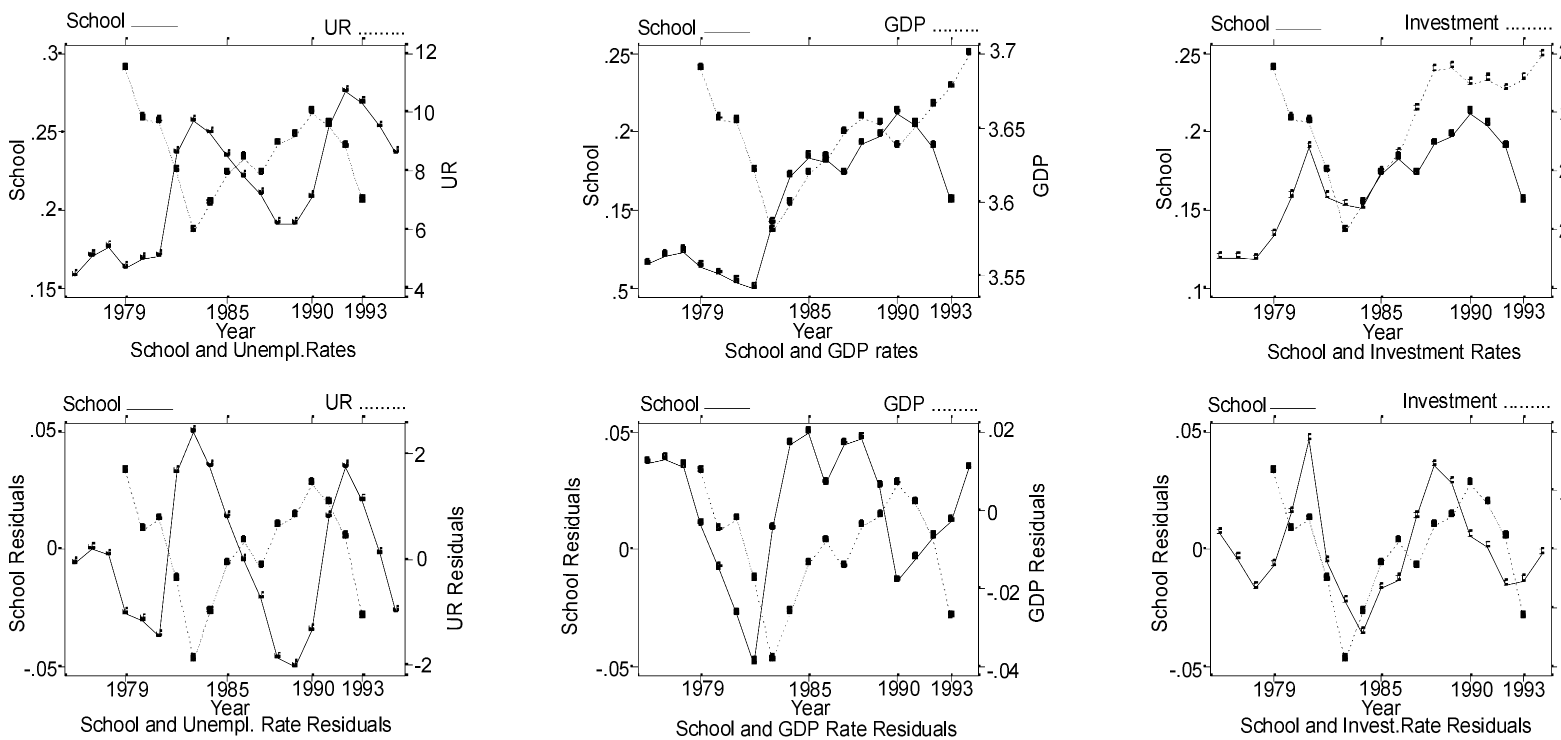
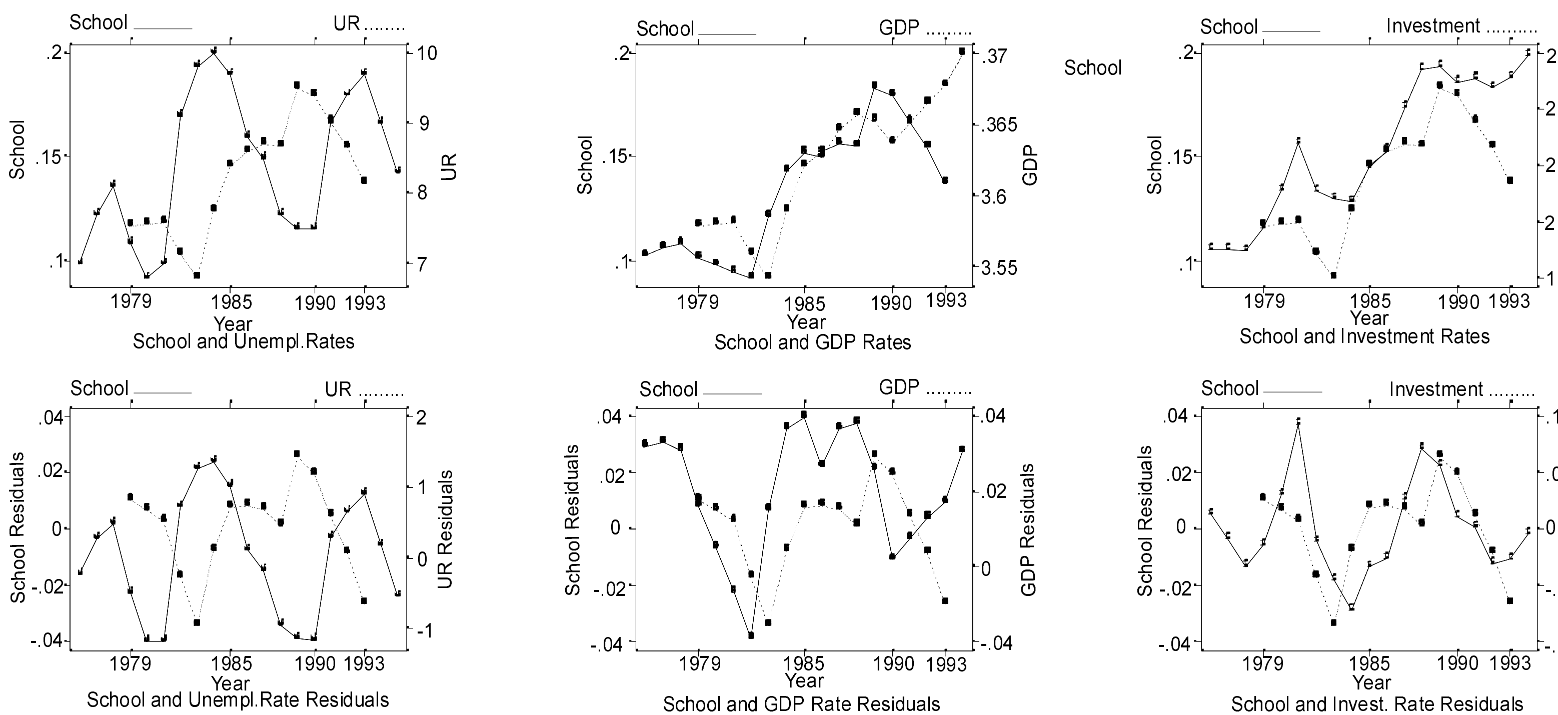


Figure 5 - Rates and H-P Residuals for Females 25-54, > 20 Weeks Worked



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Appendix 1 - CANSIM Data Series Employed

Data other than the return to school series and associated HRDC administrative data was obtained from Statistics Canada's CANSIM database. The following series were used:

D10421	Total investment in fixed capital at 1986 prices
D21251	Gross domestic product at factor cost at 1986 prices
D767137	Employed, men D770464 Employed, women 25-54 yrs
D767874	Employed, men 15 yrs and over
D768019	Employed, women 15 yrs and over
D767140	Unemployment Rate, men 25-54 yrs
D770467	Unemployment rate, women, 25-54 yrs
D767898	Unemployment rate, men 15 yrs and over
D768008	Unemployment rate, women 15 yrs and over